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FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **218131US3PCT**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **10/048170**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/05282	**4 August 2000**	**4 August 1999 (earliest)**

TITLE OF INVENTION
METHOD FOR PRODUCTION OF CERAMIC PRODUCT, AND CERAMIC PRODUCT

APPLICANT(S) FOR DO/EO/US
KUNO Hiroaki et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Drawings (5 sheets)/PCT/IB/308
Notice of Priority/Form PTO-1449
Amended Sheet (Page 15)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
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24. The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$130.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	2 - 20 =	0	x $18.00	**$0.00**	
Independent claims	1 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$1,020.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				**$0.00**	
SUBTOTAL =				**$1,020.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$1,020.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$1,020.00**	
				Amount to be: refunded	$
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a. ☒ A check in the amount of **$1,020.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

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d. ☐ Fees are to be charged to a credit card **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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21,124
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Jan 29 2002
DATE

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DESCRIPTION

METHOD FOR PRODUCTION OF CERAMIC PRODUCT, AND CERAMIC PRODUCT

TECHNICAL FIELD

The present invention relates to a method for production of a ceramic product, and to a ceramic product. The invention is favorable to musical instruments, building materials, etc., and to a method for producing them.

BACKGROUND ART

Heretofore, for example, known is a method of applying a synthetic resin to a machinable ceramic material followed by finishing the resulting, resin-dipped ceramic material into musical instruments having a desired form (Japanese Patent Laid-Open No. 181787/1990).

Compared with other conventional instruments made of wood, the instruments produced according to the method have the advantage of good durability intrinsic to the ceramic material and the synthetic resin constituting them and have good sound characteristics necessary to musical instruments not absorbing water and impervious to air. In addition, not using natural wood, the method for production is favorable for the protection of the environment.

DISCLOSURE OF THE INVENTION

Naturally, however, the ceramic product to be produced must have various characteristics necessary for their applications. Nevertheless, in the conventional method for production of a ceramic product mentioned above, musical instruments are merely produced with no consideration given to the necessary characteristics except the durability, the absence of water absorption and the air imperviousness.

Specifically, in the conventional method for production, nothing is taken into consideration relating to the applications of the ceramic product to be produced as to what characteristics are needed by the ceramic product and how the ceramic product is to be constituted so as to have the necessary characteristics. Therefore, in the conventional method for production, the ceramic product produced could have the necessary appearance and function to some degree, but are as yet not clarified as to whether or not they have surely satisfactory characteristics for their applications.

The present invention has been made in consideration of the current situation in the art mentioned above, and its object is to ensure the production of a ceramic product having satisfactory characteristics for predetermined applications.

The method for production of a ceramic product of the invention is characterized in that the desired characteristics of the ceramic product to be produced therein are first grasped,

a porous ceramic material having the first characteristic and a fluid having the second characteristic are then prepared, the fluid is at least infiltrated into the ceramic material, and at least one of the first characteristic, the second characteristic and the infiltration ratio are controlled to produce the ceramic product.

In the method for production of the invention, the desired characteristics of the ceramic product to be produced are first grasped in accordance with the use of the ceramic product.

For example, in case where the ceramic product to be produced is a sounding medium for percussion instruments such as xylophones, marimbas, clappers, castanets, percussion blocks (such as those in Buddhist temples), etc., its necessary characteristics will be high density, high hardness and small internal friction (Q^{-1}).

In case where the ceramic product to be produced is a sound plate for stringed instruments such as pianos, violins, guitars, *biwas* (four-stringed Japanese lutes), *kotos* (Japanese harps), etc., its density will have to be within a specific range, and, in addition, its specific elastic modulus will have to be high and its sound attenuation factor will have to be low.

In case where the ceramic product to be produced is a resonator pipe for woodwinds such as clarinets, recorders (English flutes), *shakuhachies* (five-holed vertical bamboo flutes), etc., its sound attenuation factor will have to be within

a specific range, and its elastic modulus (Young's modulus) will have to be within a specific range and will have to be anisotropic.

In addition, the instruments mentioned above will have to be further discussed for their other characteristics including vibration characteristics, sound radiation characteristics, vibration transmission characteristics, etc. Moreover, in case where they require machining in producing them, they must have good machinability for their mechanical characteristics. Accordingly, the sound characteristics and the mechanical characteristics of the ceramic product for such instruments are first grasped.

Regarding the vibration characteristics of instruments for percussion sounds, the beaten surface of the instruments will be readily deformed. In case where the instruments are made of a material having a longer contact time with a beating medium applied thereto, they could hardly produce sound components up to the high-frequency level, and their sounds will be mild as consisting essentially of low-frequency components.

The sound radiation characteristics of instruments are definitely reflected by the sounds that are produced by a rod sample of the same material as that of the instruments forcedly vibrated to give a flat frequency vibration sound (white noise). The sounds produced under such forced vibration give a sound spectrum to reflect the sound radiation characteristics of the instruments. The level of the sound pressure from instruments

made of a hard material greatly fluctuates at around the resonance point; but that from instruments made of a soft material fluctuates only a little. This is because the internal friction of instruments made of a hard material falls between 1/10 and 1/30 of that of instruments made of a soft material. In addition, instruments made of a hard material have a higher sound transmission efficiency (degree of sound transmission) to give vibration sounds up to a high-frequency level, with the increase in their resonance point peak. Accordingly, it is understood that instruments made of a soft material have a filter effect capable of relatively strengthening low-frequency components to thereby depress high-frequency components that are offensive to human ears. In case where a ceramic material of uniform crystal orientation is used in producing instruments and where the internal friction of the material to be caused by the strain deformation thereof in the crystal orientation direction in the instruments is enlarged for high-frequency components, the filter effect of the instruments will be remarkable under free sound attenuation condition, and will characterize the mildness of the sounds produced by the instruments. The difference between the internal friction to be caused by bending strain and that to be caused by shearing strain will also give a sound spectrum.

Vibration will be more readily transmitted from a material having a smaller intrinsic sound resistance (sound impedance)

$(E\rho)^{1/2}$, and a material having a larger specific Young's modulus (elastic modulus/specific gravity) ensures higher sound transmission and higher vibration response. Instruments made of a soft material have a low density and a low elastic modulus, and their sound resistance is low. However, in case where the soft material for instruments is a ceramic material of uniform crystal orientation, the specific Young's modulus in the crystal orientation direction of the instruments will be on the same level as that of instruments made of a hard material. Accordingly, the instruments made of such a soft ceramic material will be readily vibrated and their response to vibration change is good. The internal friction of instruments made of a soft material is large relative to the specific Young's modulus thereof. Therefore, the frequency characteristics of instruments made of a soft material are flat, compared with those of instruments made of a hard material. Accordingly, instruments made of a soft material are characterized in that each sound produced by them is rapidly attenuated and does not overlap with any others, and they will be therefore suitable to sound plates.

More concretely, in case where the ceramic product to be produced is for a mouthpiece body of a clarinet integrated with a resonator plate for a reed made of reed (plant), it must have sound characteristics including elastic modulus, internal friction, etc., and must have mechanical characteristics including machinability, etc. Therefore, for such a mouthpiece

body, the sound characteristics and mechanical characteristics of the ceramic product to be produced are first grasped.

In case where the ceramic product to be produced is for building materials or for constitutive members for machines, etc., such building materials and constitutive members must have mechanical characteristics including tensile strength, bending strength, elastic modulus, machinability, etc. Therefore, for such building materials and constitutive members, the mechanical characteristics of the ceramic product to be produced are first grasped.

With that, a ceramic material and a fluid are prepared. The ceramic material is porous, and its first characteristic must be grasped. For the ceramic material, for example, employable is a machinable, sintered ceramic substance described in Japanese Patent Publication No. 21632/1992. The first characteristic of the ceramic material includes, for example, the apparent porosity, the mean pore radius and the machinability thereof. On the other hand, liquid and gaseous materials can be used for the fluid. The liquid material includes resin and rubber. The resin may be any of thermosetting resins or thermoplastic resins. In case where the fluid is a thermosetting resin selected from acrylic resins, unsaturated polyesters, epoxy resins, ABS, etc., its second characteristic is, for example, the elastic modulus of the thermosetting resin.

Next, the fluid is at least infiltrated into the ceramic

material, and at least one of the first characteristic, the second characteristic and the infiltration ratio is controlled to produce the intended ceramic product. In case where the infiltration ratio is controlled, pores filled with air can be left in the ceramic product produced. In that case, therefore, the ceramic product produced shall have a composite structure composed of the ceramic material, the liquid such as a thermosetting resin or the solid from it, and air, and can realize the desired characteristics in a more preferred manner. In case where a thermosetting resin is used, it is infiltrated into the ceramic material and then cured therein to give a ceramic product. For the infiltration method to be employed herein, the parameters including the degree of reduced pressure or increased pressure, the processing time and the processing temperature may be suitably determined.

The ceramic product thus obtained is composed of the porous ceramic material having the first characteristic and the fluid having the second characteristic and having been infiltrated into the ceramic material or the solid from the fluid, and has the desired third characteristic attained by controlling at least one of the first characteristic, the second characteristic and the infiltration ratio. After the process, the ceramic product may be optionally post-processed for surface treatment including painting and polishing for further improving or modifying its design, quality, safety and feel.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 relates to one embodiment of the invention, showing cross-sectional views of a ceramic material with an acrylic resin being infiltrated and solidified therein.

Fig. 2 relates to the embodiment of the invention, showing cross-sectional views of a mouthpiece body produced by machining the resin-infiltrated ceramic material.

Fig. 3 relates to the embodiment of the invention, showing cross-sectional views of the mouthpiece produced by fitting a reed and other members to the mouthpiece body.

Fig. 4 relates to the embodiment of the invention, showing the front view of a clarinet.

Fig. 5 relates to evaluation 1, showing a graph that indicates the elastic modulus and the internal friction of the mouthpiece bodies of Examples 1 and 2 and Comparative Example 1.

Fig. 6 relates to evaluation 2, showing correlation diagrams of the input vibration and the output vibration into and from the mouthpieces of Example 2 and Comparative Examples 2 to 5.

Fig. 7 relates to evaluation 4, showing a graph that indicates the specific Young's modulus and the internal friction of the mouthpiece bodies of Example 2, and Comparative Examples 1 to 4 and 6 to 8.

Fig. 8 relates to evaluation 6, showing a graph that indicates the relationship of the mouthpieces of Example 2 and Comparative Example 2 between the breath pressure and the relative sound pressure in a high-pitched sound range.

Fig. 9 relates to evaluation 6, showing a graph that indicates the relationship of the mouthpieces of Example 2 and Comparative Example 2 between the breath pressure and the relative sound pressure in a low-pitched sound range.

BEST MODES OF CARRYING OUT THE INVENTION

One embodiment of the invention is described hereinunder with reference to the drawings attached hereto.

In this embodiment, produced is a ceramic product for a mouthpiece body for a clarinet. The vibration characteristics of the mouthpiece body will have an influence on the free vibration of the reed fitted to the body. When the reed is vibrated, it is opened and closed while being supported by its support, and gives periodic vibration to the mouthpiece body. With that, the mouthpiece body thus being vibrated further vibrates the reed, whereby the free vibration of the reed is combined with the sub-vibration having a different phase, thereby having an influence on the pure vibration of the reed that serves as a sound source to produce a sound tone.

Accordingly, in case where the mouthpiece body is expected to produce a sound comparable to that to be produced by

conventional ones made of a ebonite material or even a granadilla material, it is desired that the mouthpiece body has an elastic modulus (Young's modulus (E)) falling between 10 and 100 (GPa) and an internal friction (in terms of its natural logarithm, $\log Q^{-1}$) of at most 1 × 10-3 for its sound characteristics. This is because, in the mouthpiece body having a larger elastic modulus, the support to which the reed is fitted could be more tough, and such a tough support could be worked more accurately and is hardly deformed. In addition, the mouthpiece body having a larger degree of internal friction could attenuate its vibration more rapidly, and will therefore more hardly transmit its vibration to the reed.

From the results of the experiments made by the present inventors, it is believed that the mouthpiece body preferably has a specific Young's modulus (elastic modulus (E)/specific gravity (ρ)) of at least 10 (GPa) and a degree of internal friction (in terms of its natural logarithm) of at least 1×10^{-3}. More preferably, the specific Young's modulus of the mouthpiece body will be at least 15 (GPa) and the internal friction thereof (in terms of its natural logarithm) will be at least 2×10^{-3}.

Then, a ceramic material and a fluid are prepared. The ceramic material prepared herein is a machinable, sintered ceramic rod described in Japanese Patent Publication No. 21632/1992. For its first characteristic, the ceramic material has a degree of porosity of 36 %, an elastic modulus of 27.9

(GPa), and a degree of internal friction (in terms of its natural logarithm) of 4.60×10^{-4}.

The details including the degree of porosity and other parameters of high-density and low-density ceramic materials of the same type are given in Table 1 below.

Table 1

	Unit	High-Density Ceramic	Low-Density Ceramic	Remarks
Bulk Density	g/cm^3	2.1	1.9	Archimedes' method
Apparent Porosity	%	22	36	Archimedes' method
Mean Pore Radius	μm	1	0.7	porosimetry by mercury penetration
Air Permeation	cm^2/sec	0.6	1.1	under permeation pressure of 1.0 kgf/cm^2
Bending Strength	kgf/cm^2	800	650	JIS R1601
Compression Strength	kgf/cm^2	1200	750	φ10 mm × 10 mm
Young's Modulus	kgf/cm^2	5.3×10^5	3.2×10^5	sing-around method
Shore Hardness	Hs	37	31	
Volume Resistivity	Ω·cm	-	-	JIS C2141
Dielectric Constant (1 MHz)		-	-	JIS C2141
Dielectric Loss Tangent (1 MHz)		-	-	JIS C2141
Breakdown Voltage	kV/mm	5.6	16	JIS C2141 (AC 60 Hz)
Highest Temperature for Use	°C	900	1000	temperature with no bending deformation
Thermal Impact Resistance (ΔT)	°C	250	250	temperature with no bending deformation
Thermal Expansion Coefficient	liter/°C	7×10^{-6}	7×10^{-6}	room temperature to 400°C
Thermal Conductivity	cal/cm·g·°C	0.0032	0.0027	hot-wire method (at 25°C)
Specific Heat	cal/g·°C	0.19	0.19	adiabatic method
in 10 % HCl at room temperature for 24 hrs	mg/cm^2	35	its shape broken	weight loss measure method
in 10 % NaOH at room temperature for 24 hrs	mg/cm^2	0.3	0.5	weight loss measure method

The details of the machinability of high-density and low-density ceramic materials of the same type are given in Table 2 below.

Table 2

Working Condition		High-Density Ceramic	Low-Density Ceramic
Lathing Tool (carbide tool K-10)	feeding rate, mm/revolution	0.05 to 0.10	0.05 to 0.20
	depth of cut, mm	0.1 to 4.0	0.1 to 6.0
	cutting rate, m/min	30 to 40	30 to 55
Milling Tool (carbide tool K-10)	feeding rate, mm/blade	0.03 to 0.09	0.03 to 0.10
	depth of cut, mm	0.5 to 5.0	0.5 to 10.0
	cutting rate, m/min	5 to 40	5 to 80
Drilling Tool (carbide drill)	drill diameter, mm	2.0ϕ, 5.0ϕ	2.0ϕ, 5.0ϕ
	revolution, rpm	300 to 1500, 300 to 1000	300 to 2000, 300 to 1000
	feeding rate, mm/revolution	0.01 to 0.10	0.01 to 0.10

On the other hand, soft and hard acrylic resins are prepared for the fluid. For their second characteristic, the soft acrylic resin has an elastic modulus of 0.05 (GPa), and the hard acrylic resin has an elastic modulus of 3 (GPa).

Next, the soft or hard acrylic resin is infiltrated into the ceramic material. In this step, the infiltration ratio of the resin is 100 % to the pores of the ceramic material. The ceramic material infiltrated with the hard acrylic resin is Example 1; and that infiltrated with the soft acrylic resin is Example 2. Next, the acrylic resin in each ceramic material is cured. The ceramic material 1 with the cured resin therein is shown in Fig. 1, (A) and (B).

The resin-infiltrated ceramic material 1 is then machined into a ceramic product, mouthpiece body 2 shown in Fig. 2, (A) and (B). The mouthpiece body 2 is composed of the porous ceramic material having the first characteristic and the acrylic resin having the second characteristic and having been infiltrated and cured in the ceramic material. Next, this is optionally post-processed for surface treatment including painting.

The mouthpiece body 2 is fitted with a reed 4 made of reed (plant) by a fitting member 3, and with a cork 5 at its end, as in Fig. 3, (A) and (B). Thus is completed a mouthpiece 6. With that, the mouthpiece 6 is fitted into an ordinary ABS or wood member to complete a clarinet, as in Fig. 4.

(Evaluation 1)

A mouthpiece body is produced from a ceramic material alone for Comparative Example 1. The mouthpiece bodies of Examples 1 and 2 and Comparative Example 1 were compared with respect to their elastic modulus and internal friction. The results are shown in Fig. 5.

From Fig. 5, it is understood that the mouthpiece bodies of Examples 1 and 2 have the desired characteristics. Playing the clarinet having the mouthpiece body of these Examples, the players satisfied the sound tone from it.

(Evaluation 2)

Mouthpieces were produced from ebonite (this is Comparative Example 2), brass (Comparative Example 3), ebony (Comparative Example 4), and glass (Comparative Example 5). The mouthpieces of Example 2 and Comparative Examples 2 to 5 were evaluated for their vibration characteristics. To the reed of each mouthpiece, applied was an input vibration from an oscillator for 2 msec, as in Fig. 6, and the output vibration was detected by the receiver fitted to the end of each mouthpiece. The profile of the output vibration from each mouthpiece is shown in Fig. 6. The response to vibration and the vibration attenuation in each mouthpiece are given in Table 3.

Table 3

	Response to Vibration	Vibration Attenuation
Comparative Example 2	slow	high
Comparative Example 3	relatively rapid	low
Comparative Example 4	rapid	high (but fluctuated)
Comparative Example 5	rapid	low
Example 2	rapid	high

From Fig. 6 and Table 3, it is understood that the mouthpieces of Comparative Examples 3 and 5, which are made of a rigid material, brass (a type of metal) or glass, rapidly respond to vibration as their rising vibration is large, but their vibration attenuation is low as the vibration therein continues for a long period of time.

On the other hand, it is understood therefrom that the mouthpiece of Comparative Example 2, which is made of a non-rigid material, ebonite, slowly responds to vibration as its rising vibration is small, and its vibration attenuation is high as the vibration therein does not continue for a long period of time.

As opposed to these, it is understood that the mouthpiece of Example 2 rapidly responds to vibration as its rising vibration is large, and its vibration attenuation is high as the vibration therein does not continue for a long period of time. In this respect, the mouthpiece of Example 2 is similar to that of Comparative Example 4 made of ebony. However, it is to be noted that the mouthpiece of Example 2 differs from that of Comparative Example 4 in that the former gives a stable sound tone with no

fluctuation of vibration attenuation therein.

(Evaluation 3)

The mouthpiece bodies of Example 2 and Comparative Example 1 were compared with respect to their water absorption (%), specific gravity, elastic modulus (GPa), thermal conductivity (W/mk) and linear thermal expansion coefficient (cm/°C) from room temperature to 100°C. The results are given in Table 4.

Table 4

	Comparative Example 1	Example 2
Water Absorption (%)	15.3	0.37
Specific Gravity	1.92	2.09
Elastic Modulus (GPa)	31.6	41.2
Thermal Conductivity (W/mk)	1.05	1.26
Linear Thermal Expansion Coefficient (cm/°C)	7.75×10^{-6}	13.7×10^{-6}

From Table 4, it is understood that the water absorption of the mouthpiece body of Example 2 is much lower than that of the mouthpiece body of Comparative Example 1. Accordingly, it is understood that the mouthpiece body of Example 2 is free from the problem with saliva that causes sound fluctuation.

(Evaluation 4)

The mouthpiece bodies of Example 2 and Comparative Examples 2 to 4 were compared with respect to their specific gravity, Young's modulus (GPa) and internal friction (in terms of its natural logarithm). The results are given in Table 5.

Table 5

	Specific Gravity	Young's Modulus	Internal Friction $\log Q^{-1}$
Comparative Example 2	1.1	4.4	1×10^{-1}
Comparative Example 3	8.5	98	1×10^{-5}
Comparative Example 4	1.26	26.9	4.5×10^{-3}
Example 2	2.09	41.2	2.7×10^{-3}

Materials of ABS resin, acrylic resin and aluminium were prepared. Mouthpiece bodies were produced from these, ABS resin, acrylic resin and aluminium for Comparative Examples 6 to 8. The mouthpiece bodies of Example 2, Comparative Examples 1 to 4 and 6 to 8 were compared with respect to their specific Young's modulus and internal friction. The results are given in Table 6 and Fig. 7.

Table 6

	Specific Young's Modulus E/ρ	Internal Friction $\log Q^{-1}$
Comparative Example 1	16.5	7.0×10^{-4}
Comparative Example 2	3.8	1.0×10^{-2}
Comparative Example 3	11.5	8.5×10^{-5}
Comparative Example 4	21.4	4.5×10^{-3}
Comparative Example 6	4.6	7.2×10^{-3}
Comparative Example 7	6.1	6.5×10^{-3}
Comparative Example 8	26.1	2.2×10^{-4}
Example 2	19.7	2.7×10^{-3}

From Table 5, Table 6 and Fig. 7, it is understood that the mouthpiece body of Example 2 is similar to that of Comparative Example 4 made of ebony.

(Evaluation 5)

The mouthpiece body of Comparative Example 2 was compared with that of Example 2 with respect to their strain (μm) in MD (machine direction) and CD (cross direction). The results are given in Table 7.

Table 7

	Strain in MD (μm)	Strain in CD (μm)
Comparative Example 2	0	75
Example 2	0	0

From Table 7, it is understood that the strain in CD of the mouthpiece body of Comparative Example 2 is large but the mouthpiece body of Example 2 has no strain in both directions.

Fitting members No. 1 of Plates #1 to #3 and fitting members No. 2 were prepared. With any of the fitting members, a reed was fitted to the mouthpiece bodies of Comparative Example 2 and Example 2 to produce mouthpieces. These were compared with respect to their strain in MD and CD. The results are given in Table 8.

Table 8

			Strain in MD (μm)	Strain in CD (μm)
Comparative Example 2	Fitting Member No. 1	Plate #1	250	-100
		Plate #2	150	-30
		Plate #3	100	-50
	Fitting Member No. 2		400	-70
Example 2	Fitting Member No. 1	Plate #1	20	-10
		Plate #2	0	0
		Plate #3	0	0
	Fitting Member No. 2		30	-10

From Table 8, it is understood that the strain in MD and CD of the mouthpiece of Example 2 is much smaller than that of

the mouthpiece of Comparative Example 2.

(Evaluation 6)

The mouthpieces of Example 2 and Comparative Example 2 were tested to measure the sound pressure (dB) relative to the breath pressure (kPa) applied thereto. The data in a high-pitched sound range are shown in Fig. 8; and those in a low-pitched sound range are shown in Fig. 9.

From Fig. 8 and Fig. 9, it is understood that the mouthpiece of Example 2 ensures a broader dynamic sound range than that of Comparative Example 2.

From the above-mentioned evaluation tests, it is understood that the mouthpiece of Example 2 produces excellent sound tones.

Accordingly, it is understood that the mouthpiece body 2 for clarinets produced according to the embodiment of the method for production of the invention ensures really satisfactory characteristics for its use.

Needless-to-say, the invention is applicable not only to musical instruments but also to building materials and constitutive members for machines, etc.

INDUSTRIAL APPLICABILITY

Accordingly, a ceramic product having really satisfactory characteristics for their use are obtained according to the method for production of the invention.

ART 34 AMDT

10/048170
JC13 Rec'd PCT/PTO 29 JAN 2002

CLAIMS

1. (Amended) A method for production of a ceramic product which comprises the steps of preparing a porous ceramic material having the first characteristic and a fluid having the second characteristic, and at least infiltrating said fluid into said ceramic material, thereby producing said ceramic product,

the improvement being characterized in that a liquid thermosetting resin is used for said fluid, said thermosetting resin is infiltrated into said ceramic material and then cured therein, and said first characteristic, said second characteristic and the infiltration ratio are controlled in such a manner that said ceramic product has an elastic modulus (Young's modulus (E)) falling between 10 and 100 (GPa) and an internal friction in terms of its natural logarithm of at most 1×10^{-3}.

2. (Amended) A method for production of a ceramic product according to claim 1, wherein said ceramic product is a resonator pipe such as a mouthpiece for wind instruments and the like.

3. (Cancelled)

4. (Cancelled)

5. (Cancelled)

6. (Cancelled)

7. (Cancelled)

8. (Cancelled)

ABSTRACT

The desired characteristics of a mouthpiece body 2 to be produced are first grasped, a porous ceramic material having the first characteristic and an acrylic resin having the second characteristic are prepared, the acrylic resin is infiltrated and solidified in the ceramic material, and at least one of the first characteristic, the second characteristic and the infiltration ratio is controlled to produce the mouthpiece body 2. In the method, a ceramic product having satisfactory characteristics for some applications are surely produced.

Fig. 1

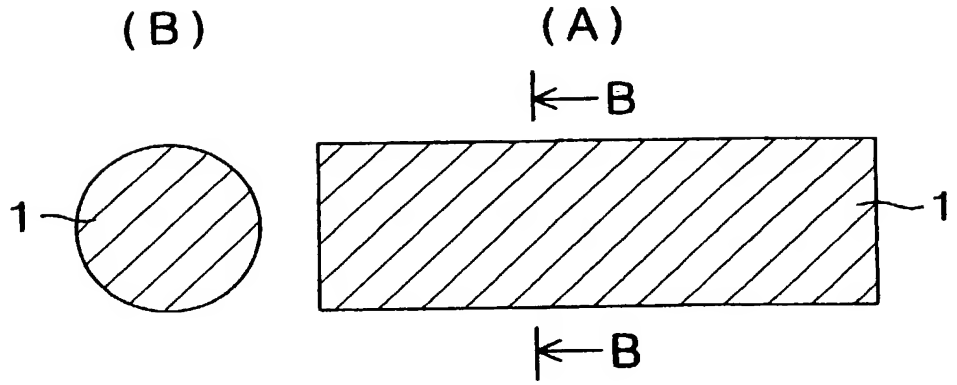


Fig. 2

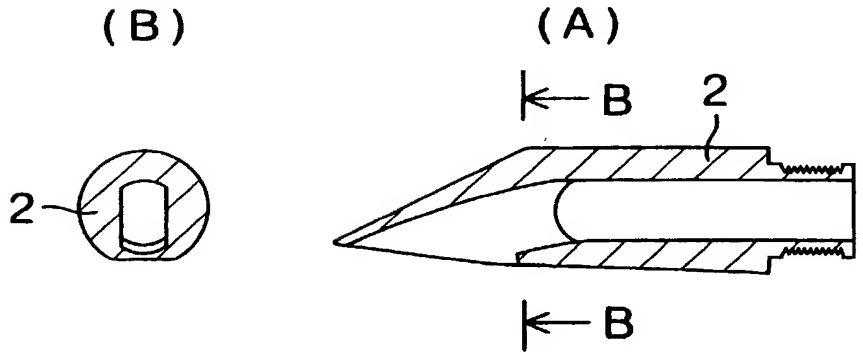


Fig. 3

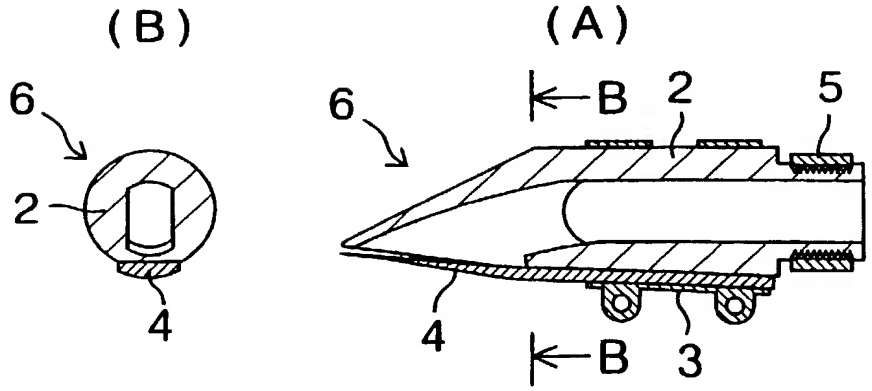


Fig. 4

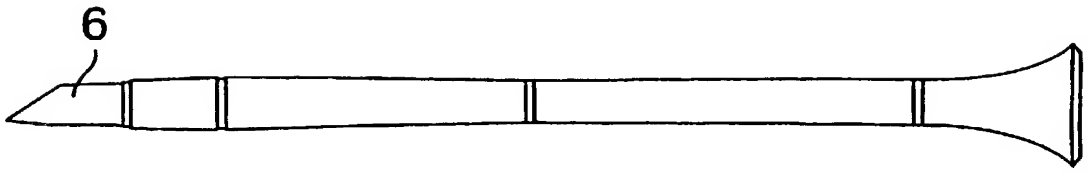

6

Fig. 5

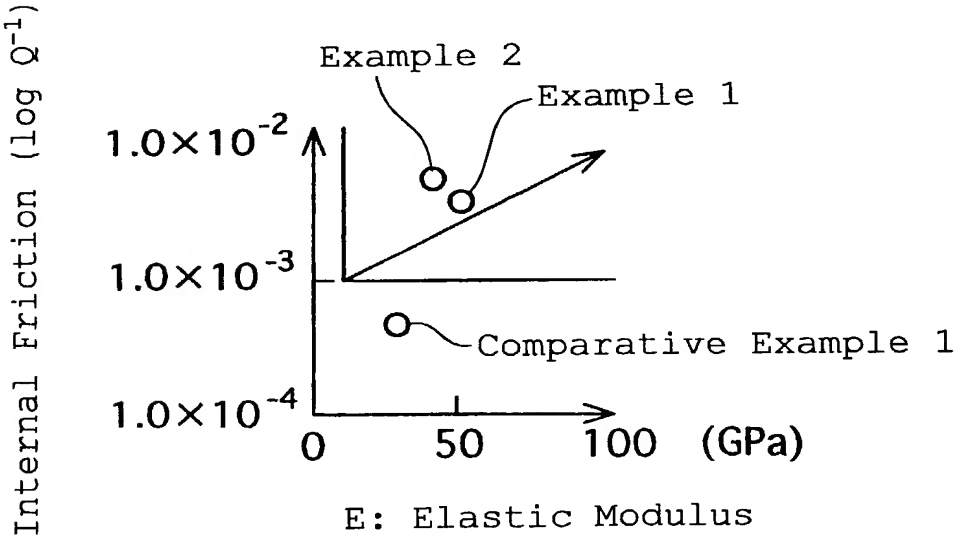

Internal Friction (log Q⁻¹)
Example 2
Example 1
1.0×10⁻²
1.0×10⁻³
Comparative Example 1
1.0×10⁻⁴
0
50
100
(GPa)
E: Elastic Modulus

Fig. 6

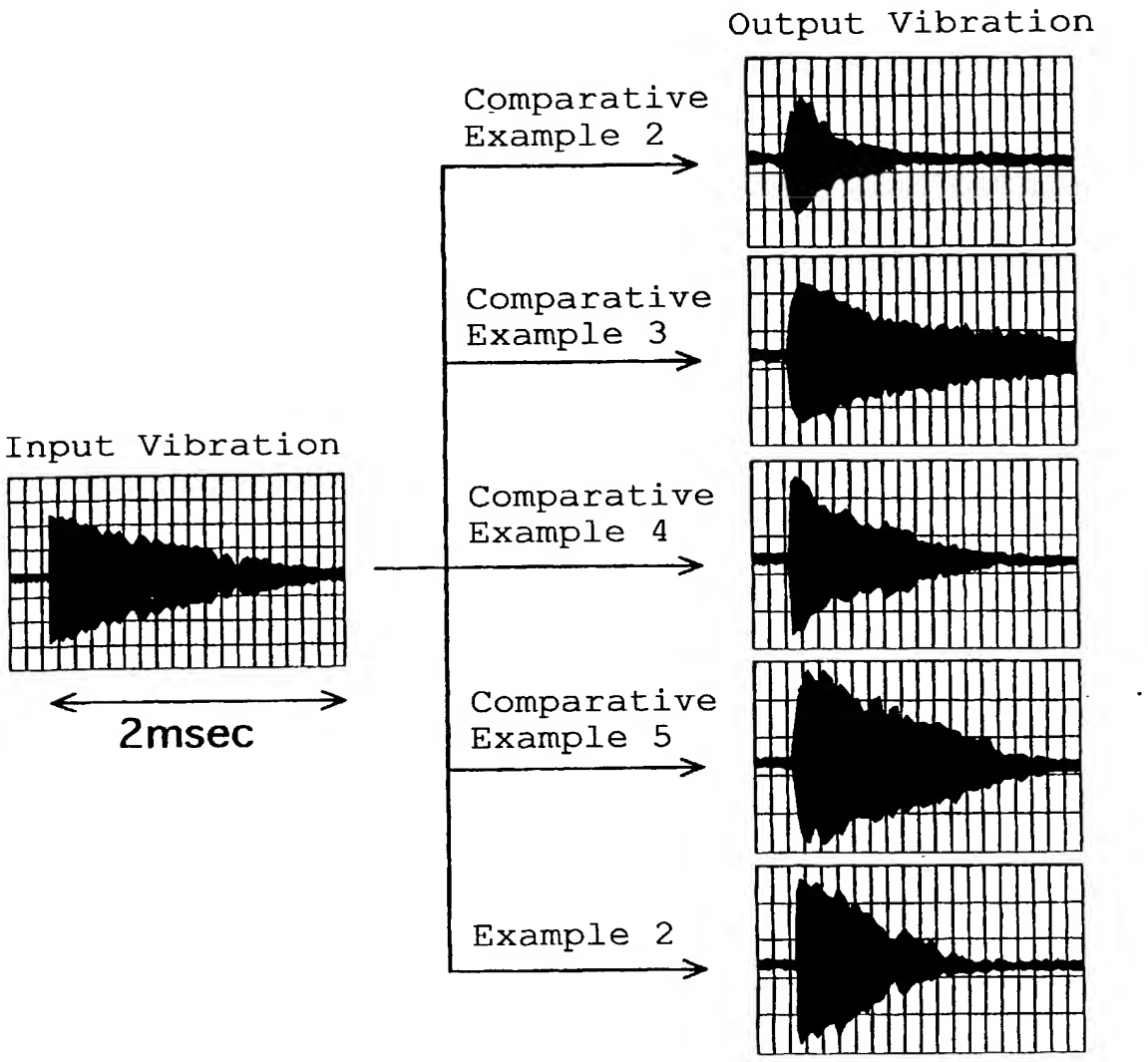

Output Vibration
Comparative Example 2
Comparative Example 3
Comparative Example 4
Comparative Example 5
Example 2
Input Vibration
2msec

Fig. 7

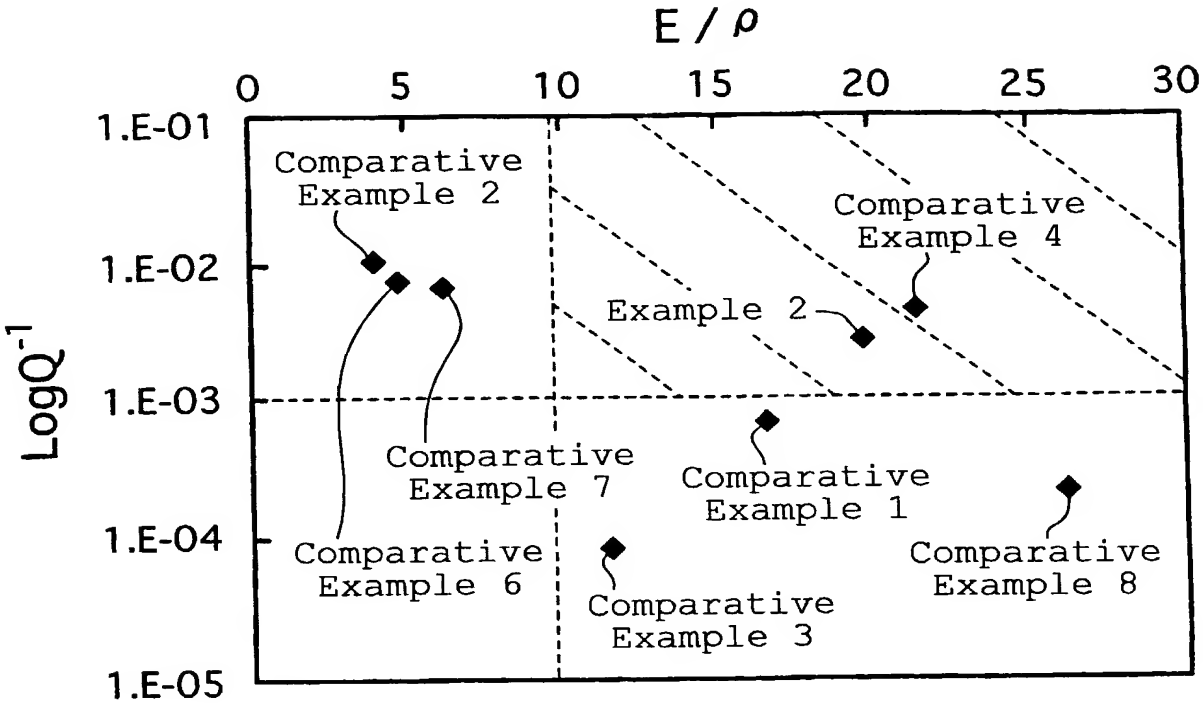

E / ρ
0
5
10
15
20
25
30
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
LogQ-1
Comparative Example 2
Comparative Example 4
Example 2
Comparative Example 7
Comparative Example 1
Comparative Example 6
Comparative Example 3
Comparative Example 8

Fig. 8

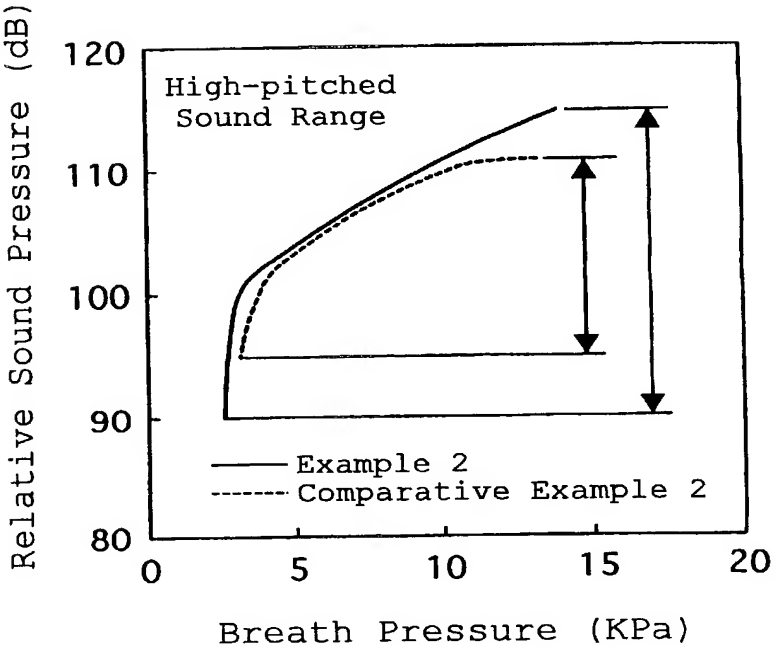
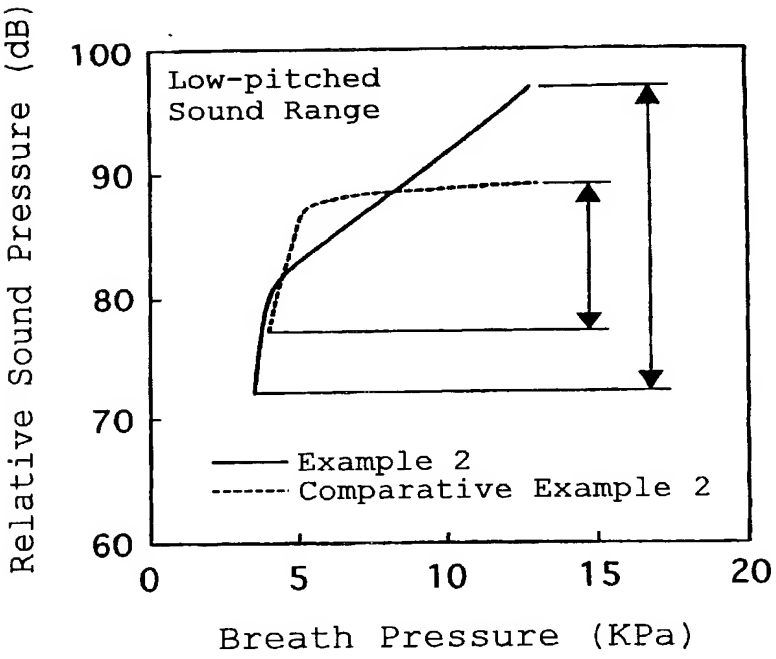

Relative Sound Pressure (dB)
120
110
100
90
80
High-pitched
Sound Range
Example 2
Comparative Example 2
0
5
10
15
20
Breath Pressure (KPa)

Fig. 9


Relative Sound Pressure (dB)
100
90
80
70
60
Low-pitched
Sound Range
Example 2
Comparative Example 2
0
5
10
15
20
Breath Pressure (KPa)

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、郵便の宛先、国籍は下記の私の氏名の後に記載された通りです。

My residence, mailing address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

METHOD FOR PRODUCTION OF CERAMIC PRODUCT, AND CERAMIC PRODUCT

上記発明の明細書は、

the specification of which

☐ 本書に添付されています。

☐ is attached hereto.

☐ _____ 月 _____ 日に提出され、米国出願番号または特許協定条約国際出願番号を

_____ とし、

（該当する場合） _____ に訂正されました。

☒ was filed on August 4, 2000

as United States Application Number or PCT International Application Number

PCT/JP00/05282 and was amended on

_____ (if applicable)

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条(a) – (d)項又は365条 (b) 項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, § 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s) 外国での先行出願			Priority Claimed 優先権主張	
11-221134 (Number) (番号)	Japan (Country) (国名)	4 August 1999 (Day/Month/Year Filed) (出願年月日)	☒ Yes はい	☐ No いいえ
2000-204284 (Number) (番号)	Japan (Country) (国名)	5 July 2000 (Day/Month/Year Filed) (出願年月日)	☒ Yes はい	☐ No いいえ

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)
PCT/JP00/05282	August 4, 2000	

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
（弁護士、または代理人の指名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

022850

書類送付先

Send Correspondence to:

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over

Japanese Language Declaration
(日本語宣言書)

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第五の共同発明者の氏名 5-00	Full name of fifth joint inventor, If any Toshiaki SHIMADZU
第五の共同発明者の署名 日付	Fifth inventor's signature Date Toshiaki Shimazu 18 March 2002
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住所	Citizenship Japan
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第六の共同発明者の氏名 6-00	Full name of sixth joint inventor, If any Masaaki NAGAMATSU
第六の共同発明者の署名 日付	Sixth inventor's signature Date Masaaki Nagamatsu 28 March 2002
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